Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GENERAL CERTIFICATE OF SECONDARY EDUCATION

A216/02

TWENTY FIRST CENTURY SCIENCE

ADDITIONAL SCIENCE A

UNIT 2: Modules B5 C5 P5 (Higher Tier)

MONDAY 28 JUNE 2010: Morning
DURATION: 40 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

Candidates answer on the Question Paper
A calculator may be used for this paper

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:

Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

DC (NF/DJ) MEP60517 31703/2

INSTRUCTIONS TO CANDIDATES

- **Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes on the first page.**
- **Use black ink. Pencil may be used for graphs and diagrams only.**
- **Read each question carefully and make sure that you know what you have to do before starting your answer.**
- **Answer ALL the questions.**
- **Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your Candidate Number, Centre Number and question number(s).**

INFORMATION FOR CANDIDATES

- **The number of marks is given in brackets [ ] at the end of each question or part question.**
- **The total number of marks for this paper is 42.**
- **A list of physics equations is printed on pages 4 and 5.**
- **The periodic Table is printed on the back page.**

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TWENTY FIRST CENTURY SCIENCE EQUATIONS

USEFUL RELATIONSHIPS

EXPLAINING MOTION

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved by the force}$$

$$\text{change in energy} = \text{work done}$$

$$\text{change in GPE} = \text{weight} \times \text{vertical height difference}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

ELECTRIC CIRCUITS

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{potential difference} \times \text{current}$$

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

THE WAVE MODEL OF RADIATION

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

Answer ALL the questions.

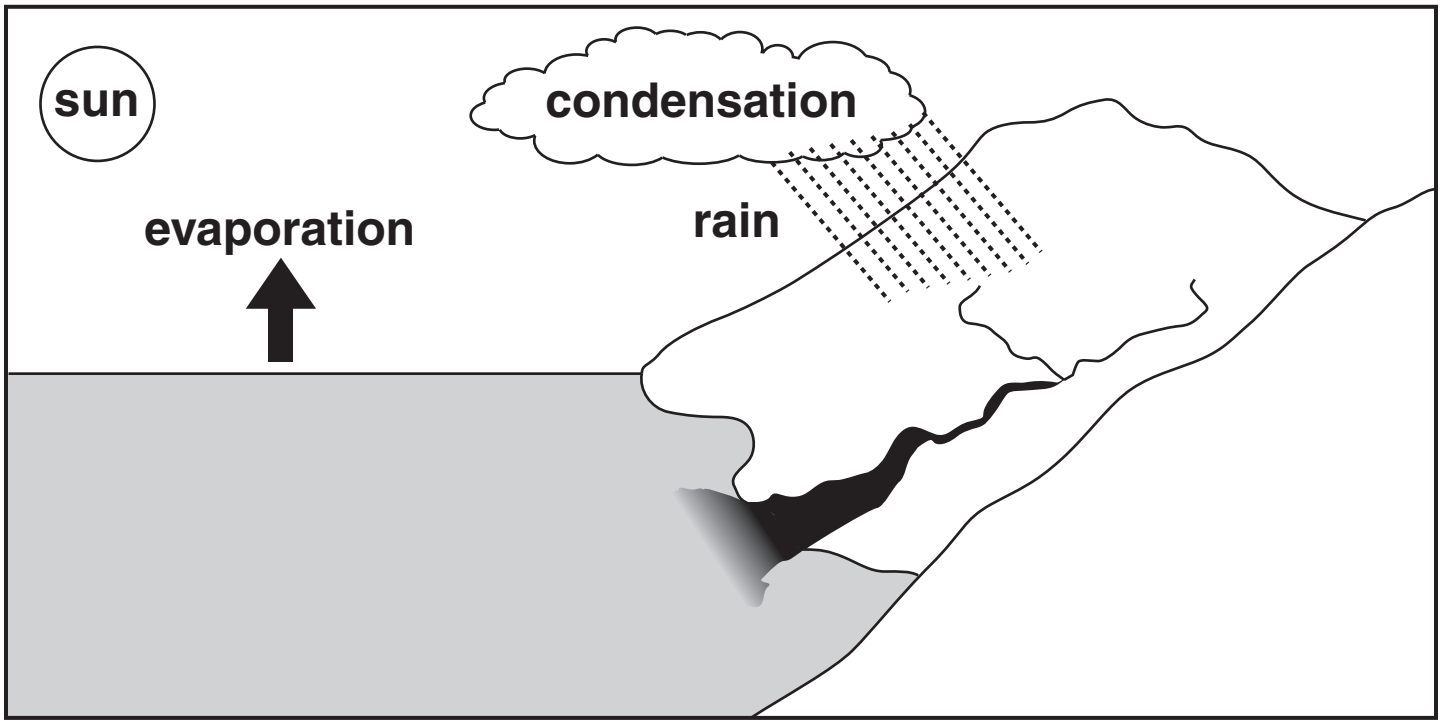
1 Chemicals such as water are vital for life.

Most of our planet is covered by water.

(a) Sea water is too salty for us to use.

The concentration of salt in the sea has increased over millions of years.

The amount of sea water has not changed much over millions of years.



Use ideas from the diagram to explain how salt gets into the sea, and why the seas have become saltier.

_____

_____

_____

_____ **[3]**

(b) Water easily evaporates into the air.

What does this tell you about water?

Draw <u>ONE</u> straight line to join the <u>TWO</u> correct boxes.

<u>WATER IS MADE OF</u>	**<u>FORCES BETWEEN WATER PARTICLES</u>**
small molecules	**strong forces of repulsion**
<u>OR</u>	**<u>OR</u>**
large molecules	**weak forces of repulsion**
<u>OR</u>	**<u>OR</u>**
a giant structure of ions	**strong forces of attraction**
<u>OR</u>	**<u>OR</u>**
a giant structure of atoms	**weak forces of attraction**

[2]

(c) Astronomers look for signs of life on other planets.

They look for water and also for other chemicals.

Put a (ring) around the chemical most likely to show that life is present.

Al_2O_3 CH_4 $CaCl_2$ $NaCl$ SiO_2

[1]

[Total: 6]

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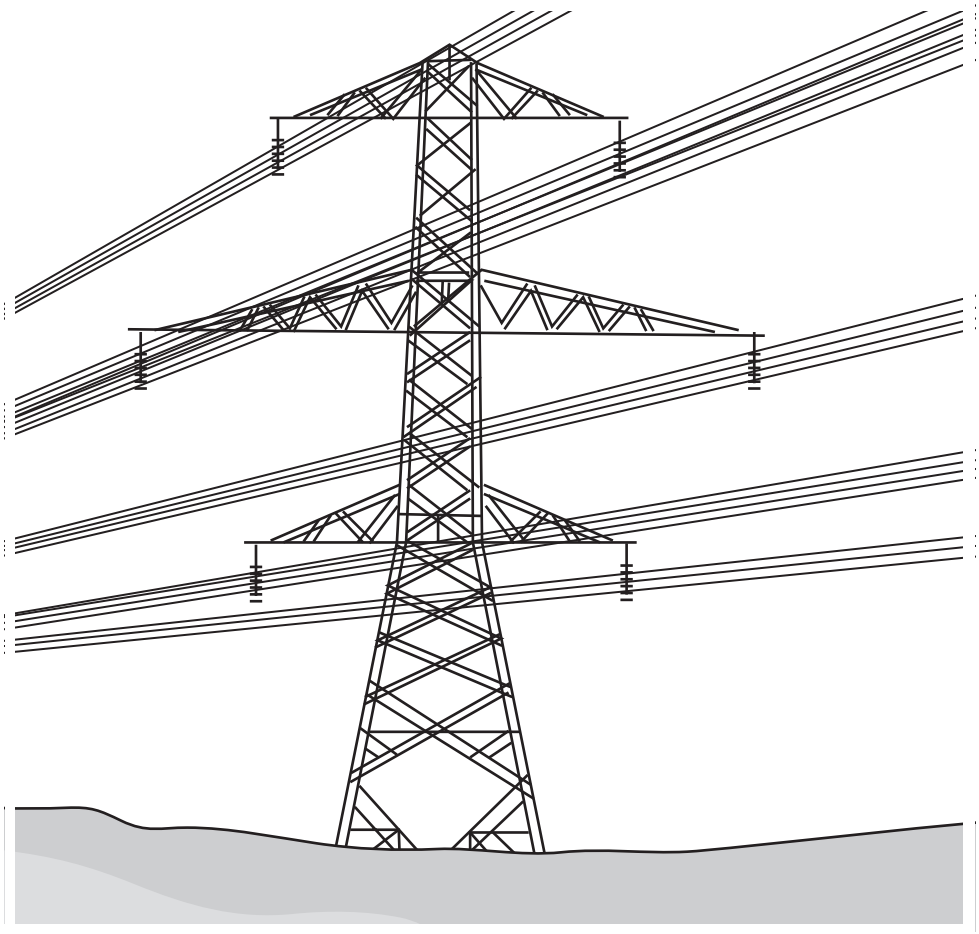
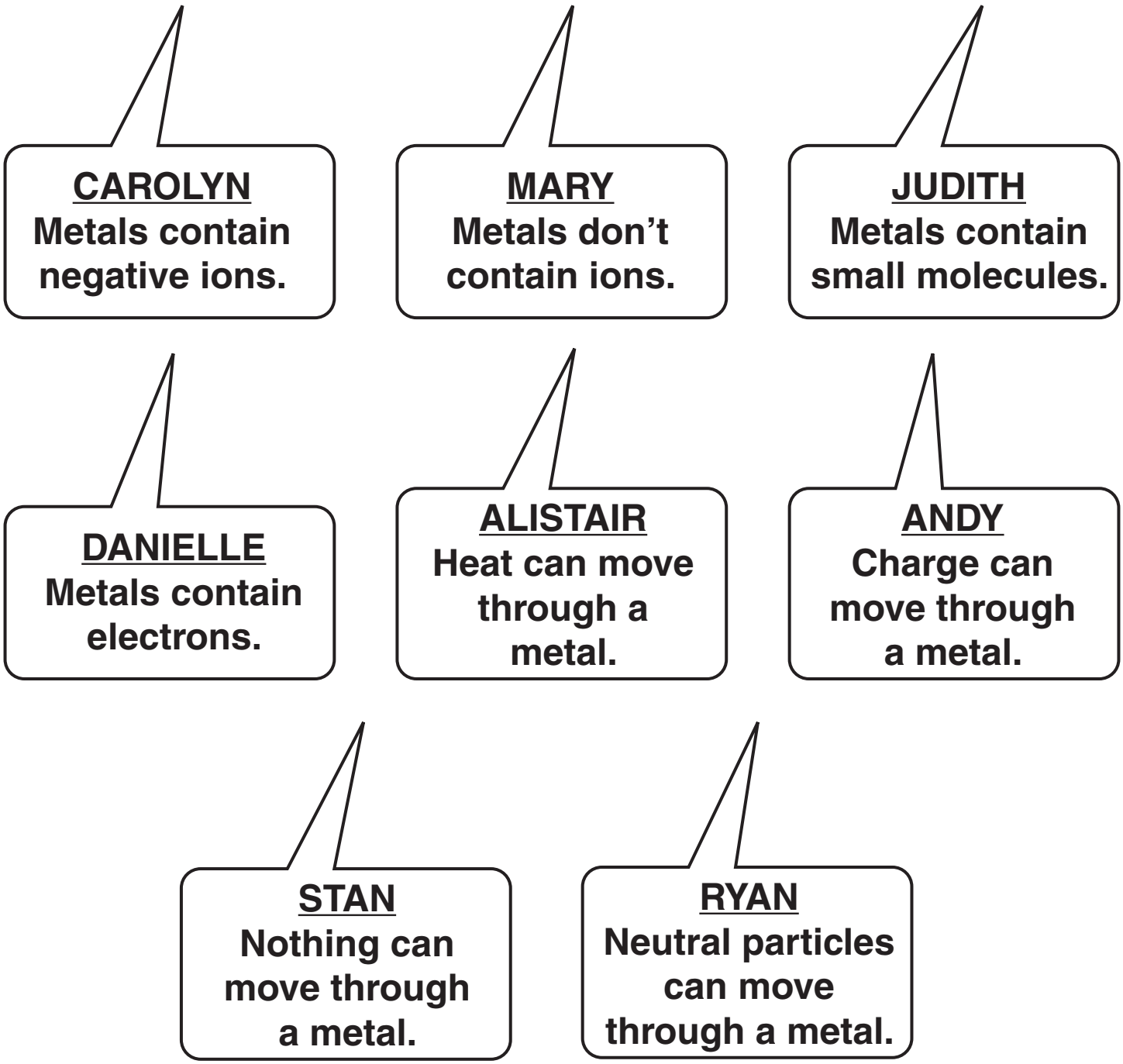
2 The electric cables carried on pylons are made from aluminium.



(a) Aluminium cables are good electrical conductors.

Some students try to explain how a solid metal conducts electricity.

Which two students make correct statements that are part of the true explanation?



answer _____ and _____ [2]

(b) The cables are suspended from tall pylons.

The cables are made of aluminium rather than copper.

Volume for volume, aluminium has 65% of the electrical conductivity of copper.

Weight for weight, aluminium has twice the electrical conductivity of copper.

Use this information to explain why aluminium is used instead of copper.

_____

_____

_____ **[1]**

(c) The aluminium used to make the cables is extracted from aluminium oxide.

Aluminium oxide is the mineral in aluminium ore.

Some ores produce 2 tonnes of aluminium oxide from 5 tonnes of ore.

Put a (ring) around the percentage of aluminium oxide in these ores.

10% 20% 25% 40% 50%

[1]

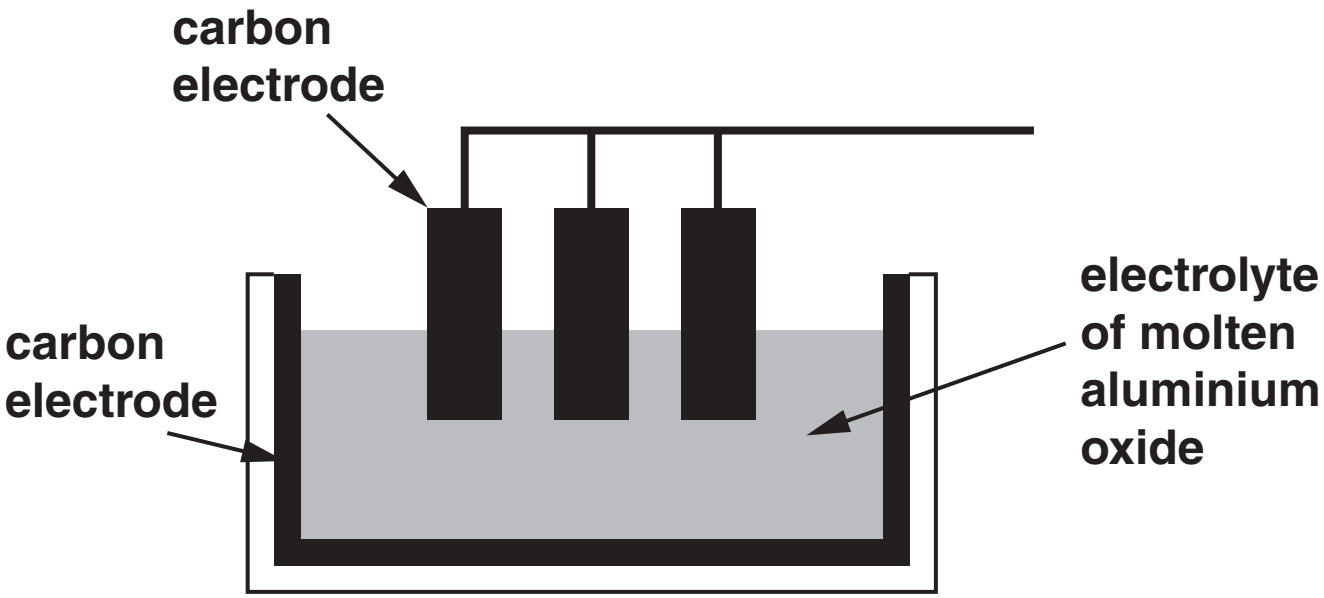
(d) To make aluminium, melted aluminium oxide is electrolysed.

Put a tick (✔) in the box next to the <u>BEST</u> description of electrolysis.

using an electric current to melt a compound	☐
using an electric current to purify a compound	☐
using an electric current to make a compound	☐
using an electric current to decompose a compound	☐

[1]

(e) Carbon dioxide gas is produced when aluminium oxide is electrolysed.



Draw a straight line to link ONE statement from COLUMN 1 with ONE statement from COLUMN 2 to explain why carbon dioxide is produced.

COLUMN 1	COLUMN 2
Oxygen is bubbled into the cell.	Oxygen reacts with the electrolyte.
OR	OR
Oxygen is not formed in the process.	Oxygen reacts with the positive electrode.
OR	OR
Oxygen is dissolved in the electrolyte.	Oxygen reacts with the negative electrode.
OR	OR
Oxygen is formed at the positive electrode.	Electrolyte reacts with the positive electrode.
OR	OR
Oxygen is formed at the negative electrode.	Electrolyte reacts with the negative electrode.

[2]

(f) What is the electrode reaction that produces the aluminium?

Put a tick (✔) in the box next to the correct answer.

$Al^{3+} + e^- \rightarrow Al$ ☐

$Al^{3+} + 3e^- \rightarrow Al$ ☐

$Al^{3+} + 3e^- \rightarrow 3Al$ ☐

$Al^{3+} + e^{3-} \rightarrow 3Al$ ☐ **[1]**

[Total: 8]

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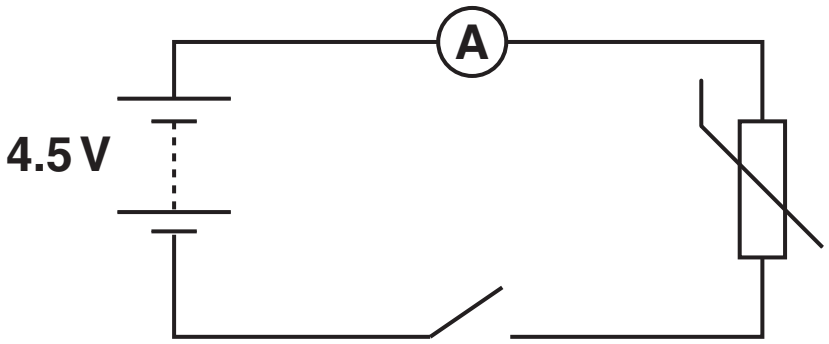
3 The circuit below contains a thermistor.



(a) Complete the sentence for a thermistor.

Choose words from this list.

CURRENT LIGHT LEVEL PRESSURE

RESISTANCE TEMPERATURE VOLTAGE

The _____ of the thermistor

increases with decreasing _____ .

[2]

(b) When the switch is closed, the ammeter reads 0.5 A.

Put a (ring) around the CORRECT value for the thermistor resistance.

0.1 Ω 2.3 Ω 5 Ω 9 Ω

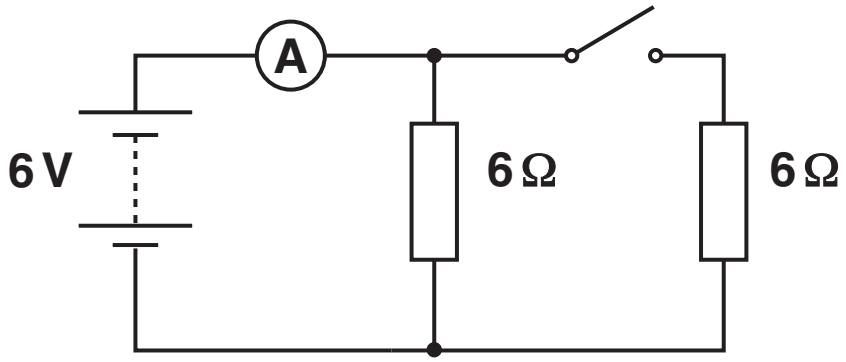
[1]

(c) A voltmeter can be used to measure the potential difference across the thermistor.

Draw the voltmeter <u>ON THE CIRCUIT DIAGRAM</u> and show how it should be connected. [1]

[Total: 4]

4 Both resistors in this circuit have the same value.



(a) Complete the sentences. Choose words from this list.

CHARGE CURRENT

RESISTANCE VOLTAGE

The energy transferred by each unit of charge as it goes around the circuit is equal to the

_____ of the battery.

Closing the switch increases the battery _____ . **[2]**

(b) Complete the table.

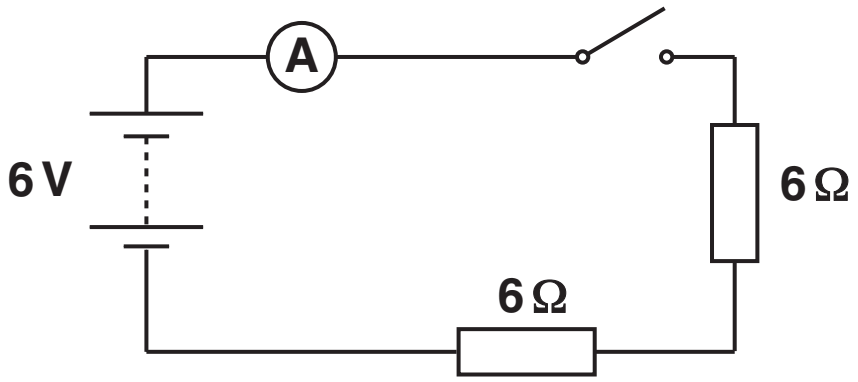
Choose numbers from the list.

0 0.5 1 2

STATE OF THE SWITCH	AMMETER READING IN AMPS
open	
closed	

[1]

(c) The two resistors are now connected in series with the switch.



Explain why the current in each resistor is 0.5 A when the switch is closed.

Show a calculation in your answer.

_____

_____

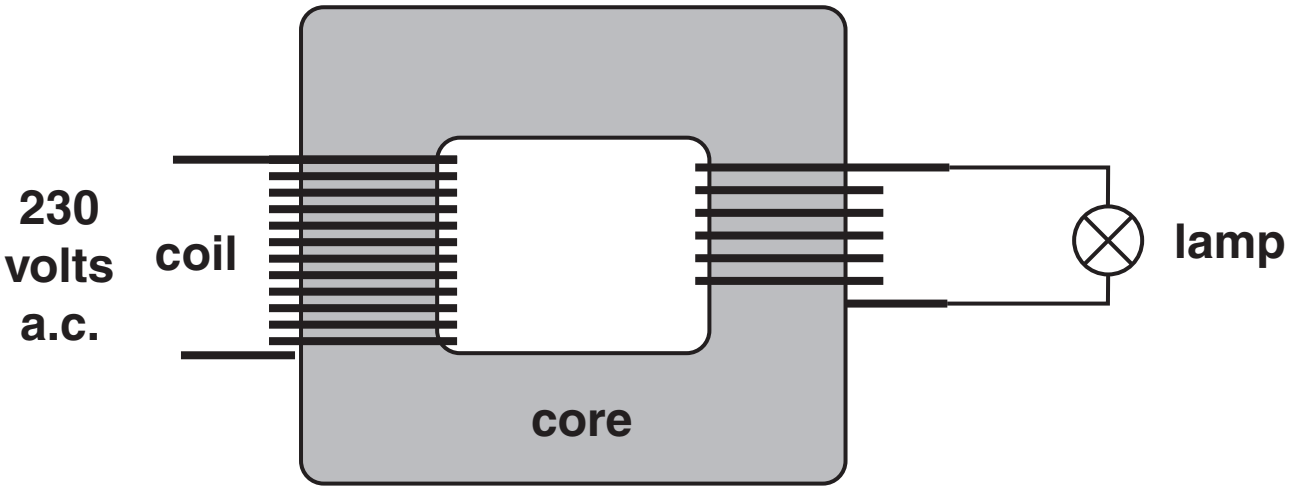
_____

_____

_____ **[2]**

[Total: 5]

5 This transformer has two coils wound on a core.



The left-hand coil of the transformer is connected to the 230V a.c. mains supply.

(a) Explain why there is an a.c. voltage across the right-hand coil.

_____

_____

_____

_____ **[3]**

(b) The left-hand coil has 180 turns and the right-hand coil has 90 turns.

What is the voltage across the lamp?

Put a (ring) around the correct answer.

90V 115V 230V 460V

[1]

(c) The lamp has a power of 0.1 kW.

It is left on for a week.

How much electrical energy does it use?

Put a (ring) around the correct answer.

0.7 kWh **2.4 kWh** **8.4 kWh** **16.8 kWh**

[1]

[Total: 5]

6 Harry takes a cutting of a plant.

He wants to know what happens to the cutting as it grows into a plant.

(a) Explain how a new plant grows from a cutting.

Your explanation should include these terms:

CLONE
HORMONE
XYLEM CELLS
UNSPECIALISED CELLS

_____

_____

_____

_____

_____ **[3]**

(b) Harry's new plant shows a positive phototropic response.

How does this increase the plant's chance of survival?

_____

_____ **[1]**

[Total: 4]

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7 The cell cycle is made up of <u>CELL GROWTH</u> and <u>MITOSIS</u>.

During mitosis a number of processes take place.

(a) Put ticks (✔) in the boxes next to the <u>TWO</u> processes that occur only during mitosis.

cells divide	☐
chromosomes are copied	☐
number of organelles increases	☐
number of nuclei stays the same	☐
copies of chromosomes separate	☐ **[2]**

(b) Another type of cell division is meiosis.

(i) What <u>TYPE</u> of cell is formed by meiosis?

_____ **[1]**

(ii) The cells made in meiosis may not all be the same size.

If one of the new cells is larger than another, what can you say about the number of chromosomes in each?

Put a tick (✔) in the box next to the correct statement.

The larger cell has more chromosomes.	☐
The smaller cell has more chromosomes.	☐
They have the same number of chromosomes.	☐
The first cell to form has more chromosomes.	☐

[1]

(c) Animal cells can now be made by cloning.

Paul is a scientist working in a laboratory cloning rabbits.

He removes the nucleus from an egg cell of one rabbit.

He then inserts a nucleus from a donor cell taken from another rabbit.

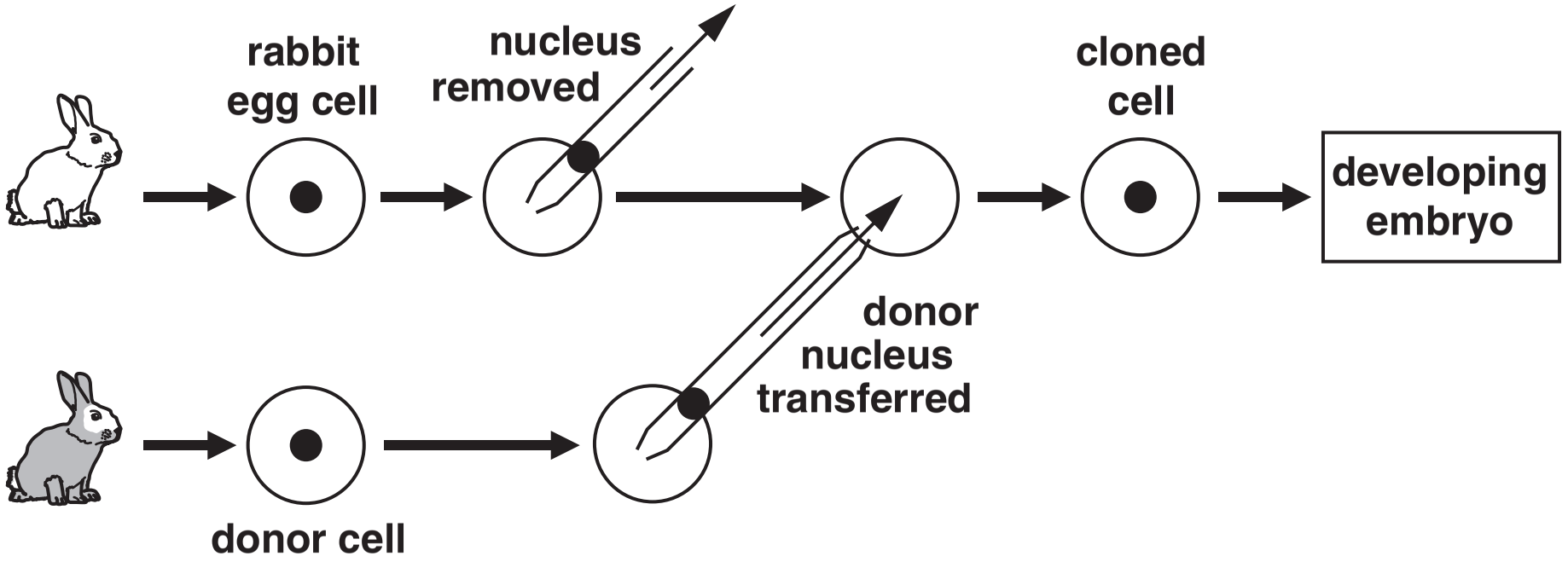
An embryo then develops as shown on page opposite.

(i) Which statement best describes what is happening to the genes from the <u>DONOR</u> cell in this process?

Put a tick (✔) in the box next to the correct answer.

All genes are activated.	☐
All genes are inactivated.	☐
All active genes are inactivated.	☐
Some inactive genes are reactivated.	☐

[1]


rabbit
egg cell
nucleus
removed
cloned
cell
developing
embryo
donor
nucleus
transferred
donor cell

(ii) In the early stages of embryo growth, only stem cells are present.

How do these cells differ from normal body cells?

Put a tick (✔) in the box next to the correct answer.

Stem cells have twice the usual number of chromosomes.	☐
Stem cells are specialised.	☐
Stem cells are unspecialised.	☐
Stem cells have half the usual number of chromosomes.	☐

[1]

[Total: 6]

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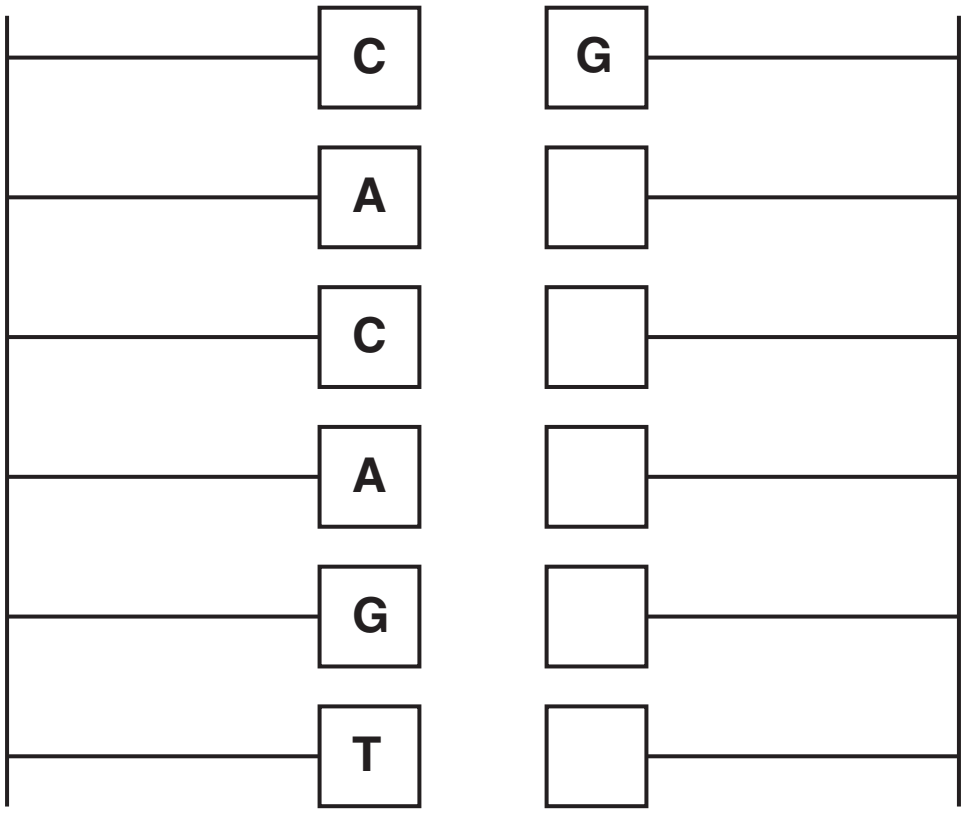
8 A length of DNA is made up of two strands.

(a) Some of the bases on the strands are shown.

Complete the diagram to show the pairing of the bases.

The first pair has been done for you.



[1]

(b) Why is the PAIRING of the bases significant?

Put ticks (✔) in the boxes next to the TWO best answers.

to make all DNA molecules different	☐
to hold the strands of DNA together	☐
to allow exact copies of DNA to be made	☐
to allow proteins to join DNA in chromosomes	☐
to allow each base pair to code for a different amino acid	☐

[1]

(c) DNA contains the genetic code to make proteins.

DNA molecules stay in one place, so a copy of the gene carries the information to where the protein is actually made.

There are several stages in the process of making protein.

Select the four correct statements from the list and place them in the correct order. One has been done for you.

A A copy of the gene moves from the nucleus to the cytoplasm.

B Fatty acid molecules join together.

C A copy of the gene moves from the cytoplasm to the nucleus.

D A copy of the information in the DNA base sequence is made.

E Amino acid molecules join together.

F The order of these determines the protein structure.

			F

[2]

[Total: 4]

END OF QUESTION PAPER

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.